

## COUNTY-WIDE MOSQUITO CONTROL

Work on Mosquito Problems in States not  
Included in the Eastern Association of  
Mosquito-Control Workers

By F. C. Bishopp

Considerable impetus has been given to mosquito control as a result of the defense work to which this country is now earnestly devoting itself. The concentration of men in new areas is certain to present a mosquito and malaria problem. This is particularly true in the South, and it is in this part of the country that many of the military activities are centered. Close cooperation between those branches of the military establishment which are charged with responsibility for antimosquito work and Federal, State, and local governmental agencies responsible for extracantonment sanitation is essential if the work is to be most effective. Unfortunately, in many areas where defense activities are most intense, mosquito-control organizations, as such, are nonexistent. In such areas the development of effective mosquito-control units and the elimination of some of the serious mosquito problems should not only safeguard the health and comfort of those engaged in defense activities but serve as a demonstration of what can be done and a stimulus to a continuing antimosquito program.

In a brief review of mosquito-control work throughout the greater part of the country it is obviously impossible to cover adequately the various activities. Furthermore, many worthwhile undertakings undoubtedly have not come to the author's attention.

The writer wishes to express appreciation to those directing mosquito control in the various States for furnishing data on, and reviewing the summary of, their work.

## Mosquito News

### Work in the South

Antimosquito work in the South has been carried on very largely as Works Progress Administration projects and for the most part under the auspices of the several State Boards of Health. In most of the Southern States the work has been directed almost exclusively against malaria mosquitoes. In some of the States administrative units concerned exclusively with antimalaria work and closely related problems have been set up. In others the work has been conducted by the units concerned with preventable diseases or some group with similar functions. The type of organization and scope of the work therefore vary considerably in different States.

In Georgia, as reported by Dr. Justin Andrews, Director of the Division of Malaria and Hookworm Service, the anti-mosquito work is carried out jointly by subdivision of the Division of Malaria and Hookworm Service and the Division of Public Health Engineering. The personnel in the first division consists of a director, medical epidemiologist, engineer, biologist, and, during the three summer months, four assistant biologists. Considerable attention is given to educational, promotional, and planning phases of malaria control, according to principles of the "Standard Plan". The work includes malarimetric and entomological surveys, special malaria investigations, and the publication of The Georgia Malaria Bulletin.

Work under the Standard Plan has gone forward during the season of 1940 in at least nine counties. Special investigations have been carried out in many other counties and assistance has been given in formulating local control problems. Where these involved filling, drainage, clearing, larviciding, and other physical methods the malaria control engineer and his assistant in the Division of Public Health Engineering supervised the works projects.

A State-wide mosquito-proofing program has been promoted by the malaria-investigations engineer in cooperation with the Federal Security Administration and the National Youth Administration.

Research has been undertaken on methods of application of larvicides, particularly paris green, on methods of identifying anopheline larvae, and on the distribution and intensity of malaria in the State and its association with environmental factors.

Funds were provided by the International Health Division of the Rockefeller Foundation for the purchase of equipment to be sent to counties to encourage the construction of precast concrete ditching materials, and to make evaluative study of the cost of anti-malaria efficiency and ditch-lining operations.

The Emory University Field Station, located near Newton, Baker County, Ga. operating under the State Board of Health, continued its studies of favorable and unfavorable conditions for the breeding of quadri-maculatus, and its study of the relationship of malaria prevalence to water levels.

In Alabama the anti-malaria work is carried out largely under the auspices of the State Health Department. Three engineers are devoting full time to malaria control and five field engineers to environmental sanitation and other phases of malaria-control work.

County health departments are becoming better organized and supported in 67 counties of the State, full-time county health departments, consisting of doctor, nurse, and secretary, being in operation. In 59 of these counties full-time sanitary officers are also provided.

For several years the State Health Department has sponsored a State-wide drainage project for malaria control, and this was continued to June, 1940.

In 1927 the State Board of Health adopted regulations governing the impounding of water. During the past year a manual on impounded water for use of the county health departments was prepared. Inspection and supervision of all artificially created ponds having an area less than 100 acres, which are subject to the regulations were carried on by the county health departments, with the assistance of the State Health Department. There are about 23 lakes that have a combined area of 200,000 acres which fall under the direct supervision of the State Health Department. The responsibility for controlling mosquito breeding in ponds falls upon the owner.

During 1940 a study and appraisal of the malaria problem of the eight Alabama counties bordering the Tennessee Valley was completed. Various aspects of the problem in each of these counties were analyzed and the results supplied to the counties for their guidance in malaria control work.

Municipal mosquito control in Alabama is the responsibility of the municipality. When a municipality requests it, an estimate of the cost of an anti-malaria campaign is made by the State Health Department. Approximately 25 municipalities carry on annual mosquito control programs.

In Mississippi, according to a statement by Nelson H. Rector, Assistant State Director of Malaria Control Work in the control of malaria is carried on under the management of the Directors of the Divisions of Sanitary Engineering and Preventable Disease Control. All engineering work in connection with the program comes under the management of the Director of Sanitary Engineering, while all medical and entomological activities, both investigational and for control, are managed by the

Director of the Division of Preventable Disease Control. Since the beginning of the permanent malaria-control program in Mississippi in May, 1936, more than 200 miles of permanently lined ditch has been constructed in 163 towns in 67 Mississippi counties on the W.P.A. Malaria Control Program. In addition, a relatively large amount of underground drains was laid and, where practicable, small ponds and swamps were eliminated by filling. These permanent ditch linings were constructed of reinforced concrete or brick and mortar, and experimental inverts were constructed of asphalt.

In Florida mosquito-control work has been carried forward along both control and research lines. Three additional counties, Palm Beach, Martin, and Sarasota, have organized mosquito-control districts. In Broward County salt-marsh mosquito control was continued during the last year under the direction of Fred H. Stutz. This work was covered by a 1-mill assessment which provided something over \$5,600 for expenditure during 1940. About 25,000 lineal feet of ditches was installed, and something over 50 lineal miles of ditches was reconditioned during the past season.

Anti-mosquito work was continued in Dade County under the direction of Mr. Stutz with funds provided through a  $\frac{1}{2}$ -mill levy. Most of the anti-mosquito work consisted of ditch maintenance and domestic-mosquito control, including inspection of premises, oiling of catch basins, and general clean-up work. An outstanding feature in the past season's work against salt marsh mosquitoes was ditching of the soft limestone rock by the use of dynamite in the heavy breeding areas on Elliott's Keys, 22 miles south of Miami. In the control of mosquito breeding in catch basins and other breeding places in the county oil was used. Paris green was largely depended upon where a lasting larvicide was needed. It proved especially valuable in such places as elevator pits, basements, cement mixers, jardineres, and many others too numerous to mention. It was found to be especially effective in unused toilet bowls and old discarded automobile tires.

The summer of 1940 was considered a bad mosquito year. Aedes taeniorhynchus was the predominant salt-marsh species involved, and Psorophora columbiae as most abundant and generally distributed than in many years. Mosquito annoyance has been noticeably less in 1941 than in 1940.

Research work on mosquitoes was carried on as heretofore by the Bureau of Entomology and Plant Quarantine at Orlando and New Smyrna and by the Rockefeller Foundation at Tallahassee and Pensacola. The work financed by the Rockefeller Foundation dealt with various aspects of the malaria problem.

At Orlando, laboratory testing of a large number of new organic compounds as mosquito larvicides was continued under the direction of Dr. W. V. King and field tests of Phenothiazine and paris green were also conducted. At New Smyrna measurements of the rates of production of salt-marsh mosquito larvae in different types of marsh and the effect of control measures on breeding, studies of chemical factors influencing the hatching of Aedes eggs, and development of sod-sampling methods determining the distribution of eggs on the marshes were the major lines of investigation followed by Mr. George H. Bradley and his associates. The cooperation of the Bureau with the East Volusia County Commission was continued. Approximately 3,700 acres of marsh have now been ditched out of approximately 20,000 acres of salt marshes in the county. About 37 percent of what appeared to be the most important areas are now ditched. The seasonal average catch of several status traps operated in Volusia County indicates a reduction of salt-marsh mosquitoes during 1940 of from 50 to 80 percent; however larval production rates on unditched marshes was also during the season.

In Louisiana John M. O'Neill, Chief of the Division of Public Health Engineering, Department of Health, reports that early in 1940, because of expected concentra-

tion of Army personnel at Camp Beauregard for the spring war maneuvers, a detailed survey was made to locate all mosquito-breeding places and particularly breeding places of malaria mosquitoes within flight range of Camp Beauregard. Methods of control were developed and arrangements were made for a comprehensive mosquito-control program. A very considerable amount of time was devoted to supervision of mosquito-control activities in the Camp Beauregard area before, during, and after the spring maneuvers in anticipation of the August maneuvers. Following the cessation of larviciding operations in the Camp Beauregard area, a report covering these activities was prepared and copies were furnished to interested governmental agencies.

In anticipation of the establishment of army training camps in Louisiana, reconnaissance surveys were made of the areas in which the camps were to be located, to determine the mosquito hazard and to estimate the amount of construction work required and the larvicidal control measures needed to protect the trainees from malaria and other insect-borne diseases. This work included consideration of communities visited by officers and trainees at night.

Plans and estimates were prepared for a larviciding project to furnish protection to officers and trainees against mosquitoes until such time as construction would make this work unnecessary. During the latter part of May of this year, arrangements were completed for this project to be operated by equipment of the State Board of Health with supplies furnished by the United States Public Health Service.

Actual larviciding operations were begun on June 2 in the Alexandria area and in the New Orleans lake-front area, and were soon extended to include the Bossier City-Barksdale Field area and the Leesville-Camp Polk area.

At the present time extensive larviciding operations are being carried on in all military areas in the State of Louisiana, with the cooperation of the Works Projects Administration. In connection with this larviciding work, experiments have been made in which both oil and commercial phenol larvicides have been used.

A considerable amount of permanent drainage work has been carried on by the Army with WPA assistance.

For Texas Dr. George W. Cox, State Health Officer, furnishes the following information concerning work in that State. During the past 2 years the Texas State Department of Health has accomplished the following in malaria control and investigation: City and county health officers were educated regarding malaria-carrier detection and eradication work, mosquito surveys were conducted for educational and estimating purposes, and consultations were held with local health officials and private physicians in dealing with chronic cases. The treatment for malaria in cooperation with eleemosynary institutions and in the Texas Prison System, dealing with the proper time to administer therapy was further developed. The development of better technic has resulted in a lower death rate for this type of work. Private physicians can now secure malaria inoculations for their parietic patients. Blood examination of over 7,000 college students was made, resulting in the detection of 79 carriers. The second year that the same colleges were surveyed only 11 carriers were detected.

Entomological studies were confined chiefly to Anopheles quadrimaculatus. An insectory has been maintained for the propagation of this species for use in malaria therapy.

Waters newly impounded to prevent mosquito propagation, received considerable attention and an extensive drainage program conducted with the use of WPA labor was



carried out.

In Arkansas mosquito-control work is directed especially against anopheline mosquitoes and is carried on under the supervision of the State Department of Public Health. William R. Horsfall, assistant entomologist at the University of Arkansas, reports that in that State 1 State-wide and 2 district faunal studies have been made. Observations on the biology of little known species have been and are under way as a part of the research program. Special attention is being given to the biologies of the floodwater species, particularly those of the genus Psorophora. In connection with survey 42 species of mosquitoes have been collected in the State. These represent 10 genera and 14 of the species are of distinct importance.

A well balanced program of malaria control is being conducted in the Tennessee Valley by the Health and Safety Department of the Tennessee Valley Authority, of which Dr. E. L. Bishop is director. The staff of the Department gives technical direction to the malaria-control operations on the 8 major and minor impoundages of the Tennessee Valley Authority. This involves more than 288,000 acres of water with 4,600 miles of shoreline. The control measures largely relied upon include water-level fluctuation supplemented by shore-line clearing and other maintenance work. This has resulted in a reduction in the amount of larvicidal work necessary. Houses on several areas near the Wheeler Reservoir have been screened as a substitute for larvicidal measures. A total of 700 houses have been mosquito-proofed.

A number of different lines of research have been carried on by the Tennessee Valley Authority, several of these being in cooperation with other governmental agencies. These include studies of the efficiency of mosquito-proofing as a malaria-control measure, new larvicides, trapping of Anopheles quadrimaculatus, the influence of water temperatures, and other ecological

factors on anopheline breeding, the use of herbicides and mechanical cutting of aquatic plants as control measures, investigations of the possibility of using various birds as laboratory animals for thermotherapeutic studies on malaria, and studies of the relation of malaria-control procedure to wildlife conservation.

Considerable study has been given to the possibility of permanent shore-line improvements such as dyking and de-watering serious mosquito breeding areas during the mosquito-breeding season with a view to reducing annual costs of maintenance and application of larvicides and providing more effective control. The first provision of this type is under construction in the Wheeler Refuge in cooperation with the Fish and Wildlife Service, Department of the Interior.

Blood surveys carried out during the fall of 1940 indicated that the malaria rate appeared to be falling as compared with 1939, while station inspections indicated that Anopheles quadrimaculatus was as prevalent as during 1939.

The U. S. Public Health Service has closed its research laboratory at Savannah, Ga. and has concentrated its research work on malaria in Memphis, Tenn., under the direction of Dr. V. H. Haas, Dr. L. L. Williams having been designated as liaison officer of the U. S. Public Health Service between the U. S. Army and the State health agencies in the Fourth Corps Area in sanitation work, including antimalaria activities. Experimental work on malaria therapeutics of the National Institute of Health is being carried forward in Washington under the direction of Dr. L. F. Small.

#### Work in the Central States

A number of local research and mosquito-control projects are under way in the Central States. Antiano-

pheline work is being pursued, particularly in southern Illinois and in Missouri.

In Illinois 8 mosquito-abatement districts are organized under the State laws, and in addition thereto work is being done in a number of larger cities and villages in the southern part of the State where a WPA project embraces 14 counties. Under this program drainage and other permanent improvements are being carried out. No spraying of mosquito larvicide is included in this program. The most intensive and extensive work in this area centers around Chicago, with the DesPlaines Valley Mosquito Abatement District taking the lead.

Mr. J. Lyell Clarke, in charge of the DesPlaines Valley work which was organized in 1927, reports that in cooperation with others a tri-county mosquito survey has been conducted and the data are being analyzed.

The DesPlaines Valley District covers 76½ square miles, and about 200,000 people reside therein. The work is sustained by taxation which cannot exceed one-half mill per dollar of assessed valuation. The work is conducted under a board of trustees of five members serving without compensation, and the employees consist of a sanitary engineer, a field engineer, a general foreman, and 4 district foreman, with 15 men and 2 inspectors employed during the breeding season. The equipment includes 4 power sprayers, equipped for use on marshes; 2 power pumps for spraying rivers and streams, mounted on barges; and 3 motorcycles for spraying catch basins. A considerable force of WPA workers is employed, and in connection with the 20" projects the District operates 1 dragline, 1 tractor and grader, and other small equipment.

Mr. Clark reports that the relative abundance of mosquitoes in the Chicago region, outside of the District, during the past season was 8 per cent below the average for 12 previous years, and that the relative abundance

of these pests within the District was 20 percent below that average. The relative abundance of mosquitoes within the District last year was 48 percent of that outside the District.

In Minnesota Dr. W. A. Riley, of the University of Minnesota, reports that during the past 6 years considerable attention has been given by him and his staff to a survey of the mosquito fauna of the State. Recently this survey has been financed to a considerable extent by the Department of Health. Thirty-eight species of mosquitoes have been reported for the State. These include 4 species of anophelines--Anopheles quadrimaculatus, A. walkeri, A. punctipennis, and A. maculipennis var. occidentalis. A. quadrimaculatus is present particularly in the southeastern part of the State along the Mississippi River, while maculipennis is most common species of the north and central parts of the State. A. walkeri is the most common of the 4 species and is widely distributed.

The seasons of 1937 and 1938 were outstanding because of the abundance of Aedes vexans. In 1939 and 1940 this species was so reduced in numbers as to elicit very few complaints. It has been abundant again in 1941 but not so troublesome as in 1937-38. The temperatures were much above normal during 1939, and along the Mississippi River south of the Twin Cities, Anopheles quadrimaculatus was very abundant. During 1940, when temperatures were more nearly normal, it was present in small numbers only.

In Wyoming a few local efforts toward mosquito control have been made. Dr. W. B. Owen, incidental to other work, is conducting a mosquito survey in the State.

#### Work in the Intermountain Region

A few local mosquito-control undertakings were carried on in 1940 in Arizona, New Mexico, Utah, and Montana. As in the past, the most notable work was

carried on under the direction of Dr. R. V. Chamberlain and Mr. Don M. Rees, of the University of Utah, in the Salt Lake Abatement District.

### Work On The Pacific Coast

In California it is reported by Dr. W. B. Herms that in 1940 mosquitoes were more than normally prevalent in most of the State owing to the excessive rainfall during the winter and spring months. Much interest has been evident in the organization of mosquito-abatement districts in Glenn, Fresno, Yuba, and Sutter Counties, and surveys made throughout the State which indicated a considerable number of cases of human encephalitis of the equine type have increased the interest of a number of counties in the Sacramento and San Joaquin Valleys in anti-mosquito work.

Two of the species of mosquitoes which previously have been incriminated as carriers of encephalomyelitis under laboratory conditions were present in areas where encephalitis in man was in evidence. These are the freshwater forms of Aedes dorsalis and A. nigromaculis. Laboratory experiments performed at the University of California have confirmed previous work showing that both Aedes dorsalis and A. nigromaculis can transmit equine encephalomyelitis, as can A. lateralis under laboratory conditions. Experiments with A. varipalpis were negative.

Mosquito-control activities in California have reached a peak in Alameda County under the superintendency of Mr. Harold F. Gray. This county was organized as a mosquito-abatement district slightly over 10 years ago. Since the district was organized, 147 miles of ditches have been constructed on 12,000 acres of marsh, 400 miles of ditches have been cleaned of filth and weeds, 16,700 acres of marsh have been oiled, and 2,400 miles of creeks, roadside ditches, and drains have been oiled. Oiling has been carried out systematically on 264,874 catch basins, and over 6,000 large pools have been stocked

with top minnows. Much educational and promotional work has been carried out and the county now enjoys the reputation of being an area relatively free from mosquito annoyance. Mr. Gray reports the average cost of mosquito-control work to the residents of the Alameda County Abatement District as \$0.08 per capita per year, and after the first year of operation the tax rate has never been higher than 1 mill.

In Oregon mosquito-control activities centered around Portland, where the efforts of city and county authorities is still directed toward the control of floodwater mosquitoes along the lower Columbia River. The seriousness of mosquito problems in Washington and Oregon was below average for 1940 and 1941, largely on account of the flood crests of the Columbia and Willamette Rivers, which were approximately 6 feet below the average in 1940 and 9 feet below the average in 1941. The rainfall in that area was also below normal, and thus trouble from Culex, Theobaldia, and Anopheles was reduced. In the Portland area control work has consisted of clearing, ditching, and oiling, as well as a certain amount of dredging and filling. The Bonneville dam has tended to reduce fluctuation of water levels between the dam on the Columbia River and The Dallas, and has covered extensive areas of willow flats which formerly were high producers of floodwater mosquitoes.

In Washington considerable attention was given to plans for mosquito control in the Yakima Valley because of the occurrence there of a considerable number of cases of human and equine encephalitis. A cooperative project is now under way in the Yakima Valley involving the Hooper Foundation of the University of California, the Infantile Paralysis Foundation, the Bureau of Entomology and Plant Quarantine, and local health authorities, in which the possible relation of mosquitoes to this disease of man and animals is being investigated. This investigation has recently borne fruit in the published announcement that

the viruses of encephalitis (St. Louis type) and the western strain of equine encephalomyelitis have been isolated from the mosquito Culex tarsalis, collected from endemic areas in the Yakima Valley.

The Bureau of Entomology and Plant Quarantine continued its research work with headquarters in Portland, Oregon, with Mr. E. F. Knipping in charge. One of the outstanding results of the work was the determination by the men at the Portland laboratory, working in cooperation with the Bacteriology Department of Oregon State College, that the reduction of oxygen in the water is an important stimulus to the hatching of the eggs of Aedes vexans and other floodwater mosquitoes. Considerable work with results of interest and economic importance was done with larvicides. The resistance of larvae of different species to different larvicides was weighed and found to differ considerably. The susceptibility of larvae in different instars was also compared, and it was found that the younger larvae were uniformly more susceptible to larvicide than the older ones.

**Aedes Aegypti Linnaeus, The Yellow  
Fever Mosquito, In Central  
Missouri**

by C. F. Adams

Late in September mosquito larvae were found in a small aquarium in the office of the State Health Commissioner. These were taken to the Laboratory of the State Department of Health where, on October 4, 1941, an adult emerged that proved to be of this species.

This location, Jefferson City, is near the center of the state, about 38.6 degrees north latitude, and probably is the "fartherest north" for the species in Missouri.

Possibility of Yellow Fever Epidemic In U. S.

According to the New York World Telegram of